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MEMORANDUM

INVESTIGATION OF AN EXTERNAL-COMPRESSION SIDE INLET AT MACH NUMBERS OF 1.6 TO 2.0

By John J. Gawienowski

Ames Research Center
Moffett Field, Calif.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MEMORANDUM 3-8-59A

INVESTIGATION OF AN EXTERNAL-COMPRESSION SIDE INLET AT MACH NUMBERS OF 1.6 TO 2.0*

By John J. Gawienowski

SUMMARY

A wind-tunnel investigation of a model with double-ramp external-compression side inlets was conducted to determine the improvements in performance attainable at angles of attack from -4° to 18° with various inlet and diffuser modifications. The tests were conducted at Mach numbers 1.60 to 2.0, and at a Reynolds number of 2.6×10^6 per foot.

Up to 6° angle of attack a porous ramp means of boundary-layer removal yielded higher total-pressure recovery, a greater range of stable mass-flow ratios, and lower compressor face distortion than an internal flush slot boundary-layer-removal system. At angles of attack greater than 6°, increasing the inlet ramp cant angle from -2° to -10° improved pressure recovery and generally increased the stable mass-flow range, but also increased distortion. The addition of a top fairing proved to be detrimental to inlet performance at angles of attack greater than 6°, while the addition of a lateral ramp extension improved pressure recovery and the stable mass-flow range but increased distortions at angles of attack up to 12°. Severe performance penalties were experienced by the inlet when a missile was mounted externally in the firing position.

INTRODUCTION

Side inlets generally experience severe performance penalties at angles of attack greater than approximately 6°. Such penalties are reduced pressure recovery, limited stable mass-flow range, and large compressor face distortions.

In order to evaluate the improvements in the performance of an inlet through the use of simple modifications, an investigation of the external-compression side inlets on a fuselage forebody of an airplane model has

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been conducted in the 9- by 7-foot test section of the Ames Unitary Plan wind tunnel. The investigation was made to determine the effects on pressure recovery, stability range, and distortion of modifications to the basic inlet. The modifications included (1) boundary-layer removal on the second ramp (ref. 1), (2) canting the ramp and raking the cowl (ref. 2), (3) addition of a top fairing, (4) addition of a lateral ramp extension, and (5) four variations of the area distributions of the subsonic diffuser. The effects of an externally mounted missile on the inlet performance were also investigated.

SYMBOLS

A_c inlet capture area (-2° canted inlet capture area equals 12.10 sq in., -10° canted inlet capture area equals 12.87 sq in.)

BLC boundary-layer control

m mass flow

M Mach number

p pressure

R Reynolds number per foot

W weight rate of flow

α_w angle of attack relative to wing reference chord (Wing reference chord is $+1^\circ$ angle of attack relative to fuselage center line.)

β angle of yaw

θ ratio of total temperature at compressor face to standard sea-level temperature

δ ratio of total pressure at compressor face to standard sea-level pressure

Subscripts

av average

c capture

cr critical

[redacted]

max maximum

min minimum

s stable

t total

∞ free stream

3 compressor station, model station 40.3 in.

APPARATUS

Model

The model consisted of a fuselage forebody with external-compression side inlets and wing stubs. A photograph of the model mounted in the test section of the Ames Unitary Plan 9- by 7-foot wind tunnel (ref. 3) is presented in figure 1, and a drawing is shown in figure 2(a).

The fuselage boundary layer was diverted by the inlet ramp mounted 0.25 inch out from the fuselage and by means of a diverter wedge as shown in figure 2(b). From a total-pressure survey at the leading edge of the inlet ramp it was found that the ratio of boundary-layer diverter height to boundary-layer thickness was equal to 1.

Two ramp cant angles were investigated and drawings indicating these angles are shown in figures 2(b) and (c). It should be noted that with the -10° canted ramp the cowl lip was raked from the top fairing to where it faired into the canted ramp at the bottom.

The top fairing and lateral ramp extension tested in the -2° cant inlet are shown in figures 2(e) and (f).

The inlet boundary-layer-removal configurations which are presented in figure 2(g) consisted of (1) a 0.125 inch wide flush slot located at fuselage station 21.89, and (2) a porous second ramp surface with a 0.02-inch gap at its leading edge. The porous area, of which the porosity was not determined, consisted of etched perforations spaced as shown in figure 2(g). The ramp boundary-layer air was removed by a bleed system which vented to the free stream at an outlet on the side of the canopy fairing.

The compression ramp angles for each inlet investigated were 5° and 8° for the first and second ramps, respectively, as shown in figure 2(g).

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The externally mounted missile configuration and the missile storage well are shown in figure 2(h).

The four subsonic diffuser area distributions tested are shown in figure 3. The length of constant cross-section area for the short step and constant area diffusers was 0.87 and 0.64 hydraulic radii, respectively.

The basic configuration, designed to operate at $M = 2.00$, and $\alpha_W = 3^{\circ}$, consisted of the -2° canted ramp inlet, the phase I cowl lip (shown in fig. 2(g)), and the phase I diffuser. The phase I cowl lip was used only with the phase I diffuser.

TEST PROCEDURE

Average total-pressure recoveries and mass-flow ratios were computed from pressure measurements taken at fuselage station 40.27, assumed first stage of the compressor, by a total- and static-pressure survey rake. Pressure recoveries were computed by the area weighing method. Mass flow was regulated by use of remotely controlled plugs at the exits of the duct passages.

Distortions which were determined from local total pressures measured at the compressor rake are defined as

$$\left(\frac{p_{t_{max}} - p_{t_{min}}}{p_{t_{av}}}\right)_3$$

A strain-gage pressure pickup cell was installed on the inboard wall of the duct at fuselage station 26.80. Indications of pressure fluctuations from this cell were used to determine the minimum stable mass-flow ratio. Duct flow was considered to be unstable when pressure fluctuations exceeded 0.05 p_{t_∞}.

All pressure ratios were determined within an accuracy of ±0.005.

TEST CONDITIONS

A summary of the configurations and parameters tested is given in table I. Test results for the configurations which are not presented in the figures have been tabulated in table II.

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RESULTS AND DISCUSSION

Performance of the Basic 5°-8° Double-Ramp Inlet

The performance of the basic 5°-8° double-ramp inlet without boundary-layer removal is presented in figure 4 for $M_\infty = 1.95$. These data show that the maximum pressure recovery at design angle of attack (3°) was much lower than that theoretically possible, and that increasing angle of attack above the design angle resulted in large losses in pressure recovery and reductions in stability range. Constant weight rate of flow lines are also shown.

Effects of Boundary-Layer Removal

In order to improve the performance at design angle of attack, the boundary layer was removed by means of (1) a porous ramp surface, and (2) an internal flush slot (see fig. 2(d)). The inlet characteristics that result from these means of boundary-layer removal are presented in figure 5. Removal of the boundary layer through a porous ramp increased maximum attainable pressure recovery by 6 percent over the solid ramp recovery with an accompanying decrease of approximately 7 percent in critical mass-flow ratio, and with no appreciable change in subcritical stability range. Further, the distortion was also reduced approximately 4 percent. The flush slot configuration increased the maximum attainable recovery by 3 percent and improved the distortion by 4 percent over that attained by the basic inlet, but a very limited subcritical stability range resulted.

Effects of Inlet Modifications on Angle-of-Attack Performance

Several inlet modifications known to improve inlet performance at angles of attack were tested. These modifications consisted of (1) canting ramp angles from -2° to -10° (see fig. 2(c)), (2) placing a fairing on top of the -2° canted inlet (see fig. 2(e)), and (3) adding a lateral extension to the ramp of the -2° canted ramp inlet (see fig. 2(f)).

The results of modifying the ramp cant angle from -2° with lateral ramp extension to -10° without lateral ramp extension are presented in figures 6(a) and 6(b). This modification improved the pressure recovery at angles of attack of 6° and above, and in general increased the subcritical stable mass-flow range and the distortion.

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The results of adding a top fairing to the inlet can be determined from a comparison of figures 6(b) and 7(a). The addition of the top fairing resulted in a decrease in pressure recovery for angles of attack greater than 6° and a decrease in stability range at $\alpha_W = 6^{\circ}$. It is also evident that the distortion was increased in general at all angles of attack.

The results of adding a lateral ramp extension are presented in figure 7, and it is seen that the pressure recovery and subcritical stability characteristics generally were improved. The distortion was increased by this modification, however, at angles of attack between 0° and 12°. Because more than one modification was often made to a test configuration, the results presented probably include aerodynamic interactions.

The inlet modifications which were used to improve the angle-of-attack performance resulted in only minor variations of compressor station total-pressure distribution with angle of attack. A typical variation of local total-pressure distribution with angle of attack is presented in figure 8. As would be expected from geometric considerations, the high pressure recovery area shifted from a position slightly below center to a position at the top of the compressor face as angle of attack increased.

Effects of Diffuser Area Distribution

To study the effects on the stability range of the inlet, the diffuser was tested with two different area distributions: (1) an initial constant area of 0.64 hydraulic radius in length faired into the aft diffuser (constant area), and (2) an initial constant area of 0.87 hydraulic radius in length which was abruptly joined to the aft diffuser (short step). Compared with the phase I modified diffuser, the results of testing these modifications showed that none of these diffusers had any significant advantage in inlet performance. Test data used for the comparison have been tabulated in table II.

Effects of an Externally Mounted Missile Configuration

A missile configuration was externally mounted as shown in figure 2(h) to determine its influence on the inlet performance. The results of this test are summarized in figure 9. At all angles of attack when the inlet would ingest the flow field disturbance from the missile and its support, the accompanying loss in pressure recovery amounted to as much as 19 percent. The inlet also experienced a large decrease in stability range, from 19 percent down to 6-1/2 percent at $\alpha_W = 6^{\circ}$, and a maximum increase in distortion from 10 to 30 percent at $\alpha_W = 10^{\circ}$.

CONCLUSIONS

An investigation has been conducted to determine the effects of various inlet modifications on the performance of a double-ramp external-compression fuselage side inlet. From the results of the investigation the following conclusions were derived:

1. Maximum attainable pressure recovery at an angle of attack of 3° was increased 6 percent over the solid ramp configuration by applying boundary-layer removal through a porous ramp. The internal slot boundary-layer-removal system increased maximum attainable pressure recovery 3 percent, but a reduction in subcritical stability range resulted.

2. Modifications such as inlet ramp canting, top inlet fairing, and lateral ramp extension did not consistently improve the angle-of-attack performance. As an example, when pressure recovery was improved, distortion generally was increased.

3. No significant improvement in inlet stability range was gained by incorporating a constant area section in the initial portion of the subsonic diffuser.

4. An externally mounted missile and its support system located in the inlet flow field caused large penalties in inlet performance.

Ames Research Center
National Aeronautics and Space Administration
Moffett Field, Calif., Dec. 8, 1958

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TABLE I.- TEST CONDITIONS

Configuration	M_∞	α_W	Figure
5°-8° double compression surface ramp with -2° inlet cant and phase I diffuser	1.95	$-4^\circ, 0^\circ, 3^\circ, 9^\circ, 18^\circ$	2(b)
(a) internal slot BLC	1.95	$-4^\circ, 0^\circ, 3^\circ$	2(b), (g)
(b) porous ramp BLC	1.95	$-4^\circ, 0^\circ, 3^\circ, 9^\circ, 18^\circ$	2(b), (g)
The following configurations had 5°-8° double compression surface ramp with porous ramp BLC vented to side of canopy:			
-10° inlet ramp cant and phase I modified diffuser	1.80, 2.00	$-3^\circ, 0^\circ, 3^\circ, 6^\circ, 9^\circ, 12^\circ, 16^\circ$	2(c)
-10° inlet ramp cant and short step diffuser	1.80, 2.00	$-3^\circ, 0^\circ, 3^\circ, 6^\circ, 9^\circ, 12^\circ, 16^\circ$	2(c)
-10° inlet ramp cant and constant area diffuser	1.80, 2.00	$-3^\circ, 0^\circ, 3^\circ, 6^\circ, 9^\circ, 12^\circ, 16^\circ$	2(c)
-10° inlet ramp cant, phase I modified diffuser, missiles expended, missile well open	1.80, 2.00 1.60	$0^\circ, 6^\circ, 9^\circ, 16^\circ$ $-3^\circ, 0^\circ, 3^\circ, 6^\circ, 9^\circ, 16^\circ$	2(c)
-10° inlet ramp cant, phase I modified diffuser, missiles in firing position	1.80, 2.00	$0^\circ, 6^\circ, 9^\circ, 16^\circ$	2(c), (h)
-2° inlet ramp cant and phase I modified diffuser	1.80, 2.00	$-3^\circ, 0^\circ, 3^\circ, 6^\circ, 9^\circ, 12^\circ, 16^\circ$	2(b)
-2° inlet ramp cant, phase I modified diffuser, lateral ramp extension	2.00	$-3^\circ, 0^\circ, 3^\circ, 6^\circ, 9^\circ, 12^\circ, 16^\circ$	2(f)
-2° inlet ramp cant, phase I modified diffuser, lateral ramp extension, top fairing on	1.80, 2.00	$-3^\circ, 0^\circ, 3^\circ, 6^\circ, 9^\circ, 12^\circ, 16^\circ$	2(d)

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TABLE II.- TEST RESULTS

Configuration: -2° canted ramp inlet with a 5°-8° ramp, phase I cowl lip, phase I diffuser, internal slot BLC

M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$	M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$	M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$
1.95	-4	1.027	0.70	0.43	1.95	0	0.851	0.85	0.12	1.95	8	0.945	0.85	0.15
		.725	.69	.12			.900	.87	.11			.930	.86	.13
		.717	.71	.08			.873	.86	.14			.882	.88	.13
		.977	.78	.22			.720	.70	.13			.826	.87	.10
		.952	.81	.17			.647	.69	.12			.585	.77	.05
		.936	.82	.15			.525	.70	.09		16	.954	.63	.68
		.918	.83	.17			1.058	.70	.55			.947	.67	.43
		.826	.85	.13			1.045	.73	.44			.954	.71	.30
		.801	.85	.14		8	1.055	.72	.40			.956	.71	.30
		.562	.65	.08			1.045	.74	.37			.529	.60	.12
	0	1.012	.79	.27			1.014	.77	.31			.647	.56	.39
		.977	.83	.19			.989	.79	.19			.647	.57	.38
		.966	.85	.13			.975	.83	.15					

Configuration: -2° canted ramp inlet with a 5°-8° ramp, phase I cowl lip, phase I diffuser, porous ramp BLC

M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$	M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$	M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$
1.95	-4	1.001	.75	.34	1.95	0	.807	.88	.09	1.95	8	1.034	.75	.37
		.950	.79	.24			1.017	.77	.40			1.049	.72	.38
		.924	.81	.20			.915	.86	.12		16	.949	.66	.34
		.898	.83	.18		8	.991	.79	.21			.961	.70	.36
		.818	.81	.13			.972	.83	.16			.953	.72	.34
	0	.978	.80	.14			.924	.87	.12			.915	.73	.33
		.944	.24	.17			.881	.89	.10			.953	.73	.32
		.909	.86	.12			.844	.89	.10			.907	.73	.31
		.896	.87	.11			.812	.89	.11			.605	.60	.43
		.857	.88	.10			.747	.83	.07			.690	.59	.40
		.824	.89	.08			.711	.83	.08					

Configuration: -10° canted ramp inlet with a 5°-8° ramp, short step diffuser, porous ramp BLC

M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$	M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$	M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$
1.80	-3	.878	.66	.42	1.80	12	.894	.82	.31	2.00	6	.939	.83	.25
		.885	.67	.41			.861	.86	.25			.917	.84	.21
		.920	.72	.52			.848	.87	.23			.914	.85	.20
		.836	.80	.27			.835	.88	.19			.818	.85	.11
		.806	.81	.20			.816	.89	.19			.620	.73	.07
		.795	.81	.20			.809	.89	.18		9	.998	.79	.30
		.662	.74	.17			.761	.90	.16			.969	.83	.25
		.741	.81	.16			.719	.90	.12			.946	.84	.21
	0	.905	.73	.52			.615	.85	.06			.934	.85	.20
		.898	.78	.40		16	.859	.79	.36			.904	.86	.18
		.869	.83	.29			.848	.82	.30			.880	.86	.14
		.831	.86	.21			.834	.83	.28			.773	.72	.15
		.805	.87	.18			.806	.84	.25		12	.982	.77	.32
		.727	.88	.15			.751	.78	.30			.969	.81	.28
		.665	.80	.11			.736	.76	.29			.950	.82	.24
	3	.910	.77	.44			.671	.74	.29			.925	.84	.20
		.897	.83	.32	2.00	-3	.982	.65	.66			.902	.84	.18
		.873	.86	.26			.914	.72	.30			.910	.84	.17
		.834	.89	.19			.886	.73	.22			.801	.71	.22
		.800	.90	.15			.819	.73	.22		16	.937	.73	.36
		.729	.91	.12			.805	.73	.24			.927	.76	.32
		.682	.87	.11			.932	.69	.38			.913	.77	.30
	6	.890	.83	.30		0	1.020	.69	.55			.859	.71	.38
		.874	.87	.24			1.000	.72	.44			.906	.77	.30
		.860	.88	.22			.969	.76	.36			.813	.69	.41
		.831	.89	.19			.897	.78	.20					
		.804	.90	.17			.868	.79	.16					
		.758	.91	.14			.806	.79	.14					
		.710	.91	.11			.752	.72	.17					
		.644	.88	.09		3	1.018	.72	.48					
	9	.898	.83	.30			.973	.78	.33					
		.868	.87	.24			.964	.80	.29					
		.850	.88	.21			.920	.83	.20					
		.831	.89	.18			.903	.83	.18					
		.804	.90	.16			.839	.84	.12					
		.769	.91	.14			.771	.78	.12					
		.743	.91	.11		6	.993	.79	.33					
		.693	.88	.09			.974	.82	.28					

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TABLE II.- TEST RESULTS - Continued

Configuration: -10° canted ramp inlet with a 5°-8° ramp, constant area diffuser, porous ramp BLC

M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$	M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$	M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$
1.80	-3	0.913	0.72	0.58	1.80	12	0.859	0.82	0.31	2.00	6	1.026	0.79	0.34
		.881	.82	.26			.869	.87	.23			1.014	.84	.26
		.815	.83	.21			.827	.88	.30			.960	.85	.22
		.735	.80	.18			.831	.90	.18			.942	.85	.19
		.683	.74	.17			.808	.90	.15			.916	.86	.15
	0	.922	.74	.53			.702	.90	.10			.791	.85	.11
		.915	.80	.37			.628	.83	.08			.753	.78	.10
		.892	.85	.24		16	.850	.80	.35		9	.986	.79	.33
		.843	.87	.19			.847	.84	.28			.990	.83	.25
		.796	.88	.17			.828	.84	.25			.955	.85	.23
		.729	.86	.14			.764	.81	.28			.951	.85	.20
		.692	.82	.13			.745	.77	.31			.902	.86	.16
	3	.915	.77	.48			.793	.83	.25			.883	.86	.14
		.914	.87	.23			.758	.78	.31			.788	.73	.17
		.905	.86	.26	2.00	-3	.957	.64	.69		12	.967	.78	.32
		.901	.88	.22			.956	.73	.33			.963	.82	.27
		.849	.90	.14			.880	.74	.22			.943	.83	.23
		.816	.91	.13			.829	.71	.25			.918	.84	.19
		.717	.90	.10			.773	.65	.25			.893	.85	.17
		.682	.87	.09		0	1.006	.67	.66			.882	.85	.15
	6	.900	.85	.29			1.012	.72	.46			.803	.71	.25
		.904	.89	.21			1.022	.78	.31		16	.941	.73	.38
		.884	.90	.19			.926	.79	.22			.921	.76	.30
		.836	.91	.16			.889	.80	.19			.908	.77	.28
		.839	.91	.16			.857	.79	.21			.837	.69	.42
		.698	.91	.10			.793	.73	.19			.828	.68	.43
		.693	.90	.10		3	1.032	.72	.54			.908	.77	.28
	9	.874	.84	.28			1.013	.79	.30			.906	.77	.28
		.873	.88	.21			.996	.82	.24			.848	.69	.43
		.851	.89	.17			.927	.84	.19					
		.823	.90	.16			.850	.84	.14					
		.809	.91	.14			.830	.84	.13					
		.727	.91	.11			.780	.78	.13					
		.696	.90	.10										

Configuration: -10° canted ramp inlet with a 5°-8° ramp, phase I modified diffuser, porous ramp BLC, missiles wells open

M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$	M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$	M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$
1.60	-3	.829	.80	.36	1.60	16	.788	.91	.19	1.80	16	.743	.81	.23
		.763	.90	.18			.768	.94	.13			.853	.79	.27
		.651	.91	.13			.737	.95	.12	2.00	0	.999	.71	---
		.596	.83	.12			.704	.95	.12			.985	.76	.32
		.752	.86	.20			.554	.94	.06			.968	.80	.23
		.787	.84	.27			.509	.93	.05			.930	.80	.21
	0	.829	.80	.36	1.80	0	.851	.88	.15			.831	.81	.17
		.806	.90	.19			.825	.90	.13			.789	.79	.15
		.773	.93	.13			.788	.89	.14		6	.999	.83	.20
		.738	.95	.12			.762	.89	.11			.968	.88	.16
		.635	.93	.10			.717	.89	.11			.944	.88	.14
		.574	.92	.08			.662	.85	.10			.890	.88	.11
	3	.828	.84	.29		6	.905	.88	.20			.759	.86	.06
		.804	.90	.19			.883	.92	.14			.717	.84	.05
		.776	.95	.13			.848	.93	.12		9	.957	.88	.16
		.733	.96	.10			.808	.93	.10			.923	.89	.13
		.541	.93	.07			.664	.93	.08			.901	.89	.11
		.475	.92	.05			.618	.90	.06			.861	.89	.11
	6	.775	.92	.17		9	.906	.89	.18			.782	.87	.07
		.787	.95	.14			.864	.93	.13			.722	.80	.09
		.743	.95	.12			.835	.93	.12			1.044	.80	.23
		.711	.95	.12			.789	.94	.09			1.029	.83	.20
		.537	.94	.07			.713	.93	.09			.977	.88	.15
		.497	.94	.06			.672	.91	.08			.970	.88	.17
	9	.801	.91	.19			.865	.90	.16		16	.893	.76	.28
		.775	.95	.13		16	.858	.82	.24			.961	.76	.26
		.744	.96	.13			.835	.83	.23			.932	.77	.26
		.716	.96	.11			.808	.84	.22			.892	.76	.28
		.501	.94	.07			.783	.84	.22			.841	.72	.34
		.472	.94	.06			.771	.83	.22			.981	.70	.37

[redacted]

[redacted]

TABLE II.- TEST RESULTS - Concluded

Configuration: -10° canted ramp inlet with a 5°-8° ramp, phase I modified diffuser, porous ramp BLC, missiles in firing position														
M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$	M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$	M_∞	α_w, deg	m_3/m_∞	p_{t_3}/p_{t_∞}	$\Delta p/p_{t_3}$
1.80	0	0.913	0.77	0.39	1.80	16	0.717	0.65	0.34	2.00	6	0.880	0.79	0.17
		.893	.82	.25			.699	.66	.29			.895	.80	.18
		.867	.88	.15			.669	.65	.27			.887	.80	.16
		.817	.90	.12			.627	.64	.25		9	.918	.73	.30
		.762	.89	.11			.657	.65	.28			.888	.74	.27
		.727	.85	.12			.654	.65	.27			.849	.72	.26
	6	.874	.84	.22			.721	.64	.37			.921	.71	.33
		.864	.88	.17			.728	.62	.42			.882	.73	.27
		.838	.88	.16	2.00	0	1.005	.70	.40			.866	.73	.26
		.809	.89	.14			.970	.75	.29		16	.787	.61	.39
		.750	.89	.11			.965	.79	.20			.760	.60	.34
		.725	.88	.10			.888	.80	.18			.723	.59	.32
	9	.845	.79	.29			.865	.79	.18			.691	.58	.28
		.829	.81	.24			.853	.77	.18			.733	.60	.32
		.794	.80	.23			.985	.70	.39			.728	.60	.33
		.843	.76	.31		6	.971	.78	.26					
		.805	.81	.24			.950	.80	.22					
		.803	.81	.18			.919	.80	.21					
Configuration: -2° canted inlet with a 5°-8° ramp, phase I modified diffuser, porous ramp BLC														
1.80	-3	.873	.78	.31	1.80	3	.743	.91	.05	1.80	9	.646	.92	.04
		.866	.80	.27			.695	.92	.04			.613	.88	.04
		.846	.81	.22			.607	.91	.07		12	.906	.64	.42
		.841	.83	.18			.555	.88	.06			.863	.82	.14
		.830	.84	.18		6	.866	.82	.13			.804	.87	.09
		.809	.84	.19			.836	.88	.08			.727	.89	.07
		.661	.80	.12			.783	.90	.06			.694	.89	.07
		.714	.84	.17			.710	.92	.04			.689	.89	.07
	0	.901	.73	.34			.664	.93	.04			.665	.88	.07
		.878	.78	.30			.643	.92	.03			.632	.84	.06
		.840	.86	.14			.604	.91	.06		16	.847	.75	.20
		.772	.89	.11			.516	.87	.06			.825	.78	.15
		.723	.90	.09		9	.855	.81	.15			.785	.80	.13
		.679	.90	.08			.841	.87	.09			.734	.82	.13
		.635	.87	.07			.770	.89	.07			.722	.82	.14
	3	.888	.77	.17			.719	.91	.05			.699	.81	.15
		.862	.83	.24			.681	.92	.05			.638	.75	.12
		.819	.89	.07			.685	.92	.05					

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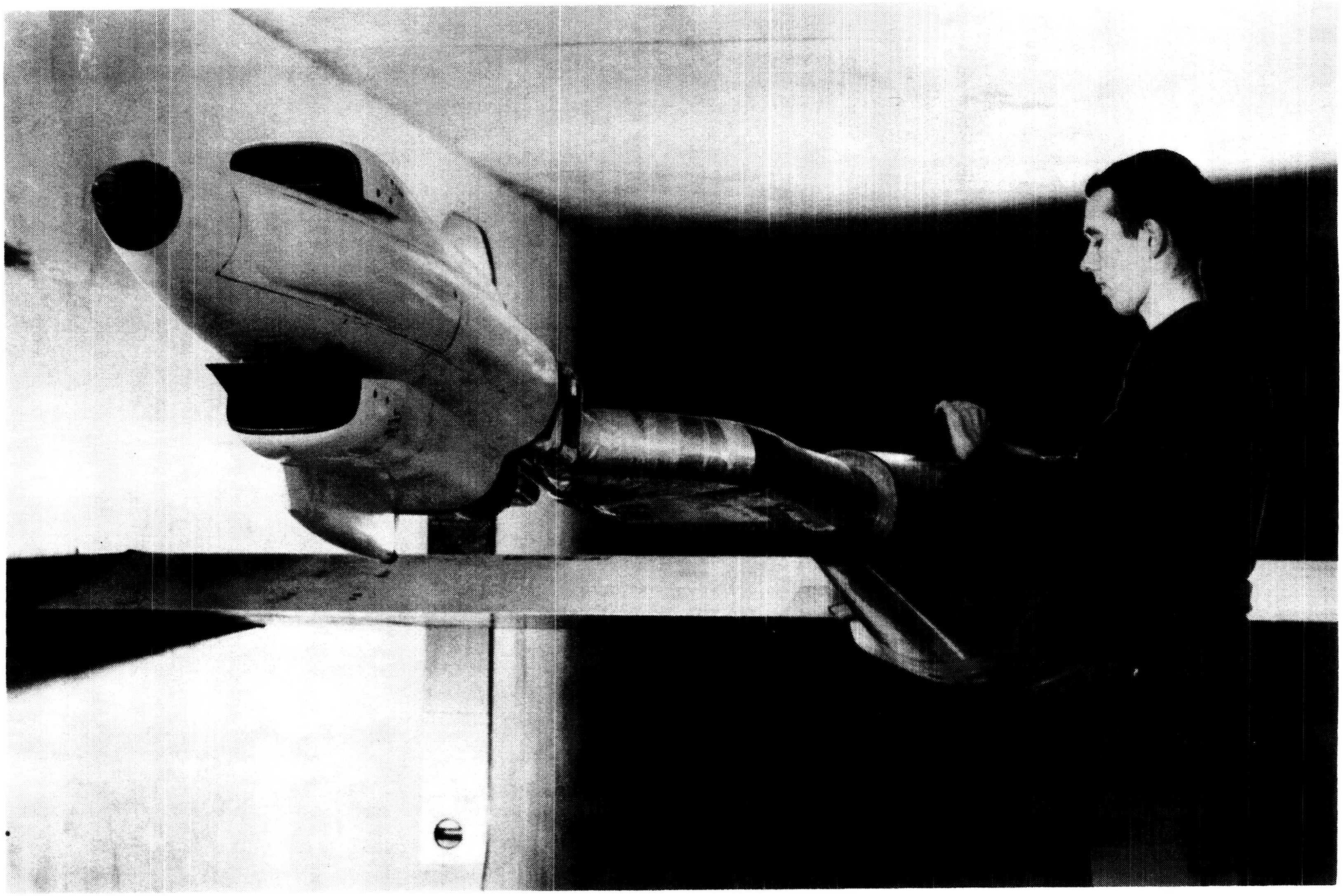

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Figure 1.- Inlet model mounted in tunnel.

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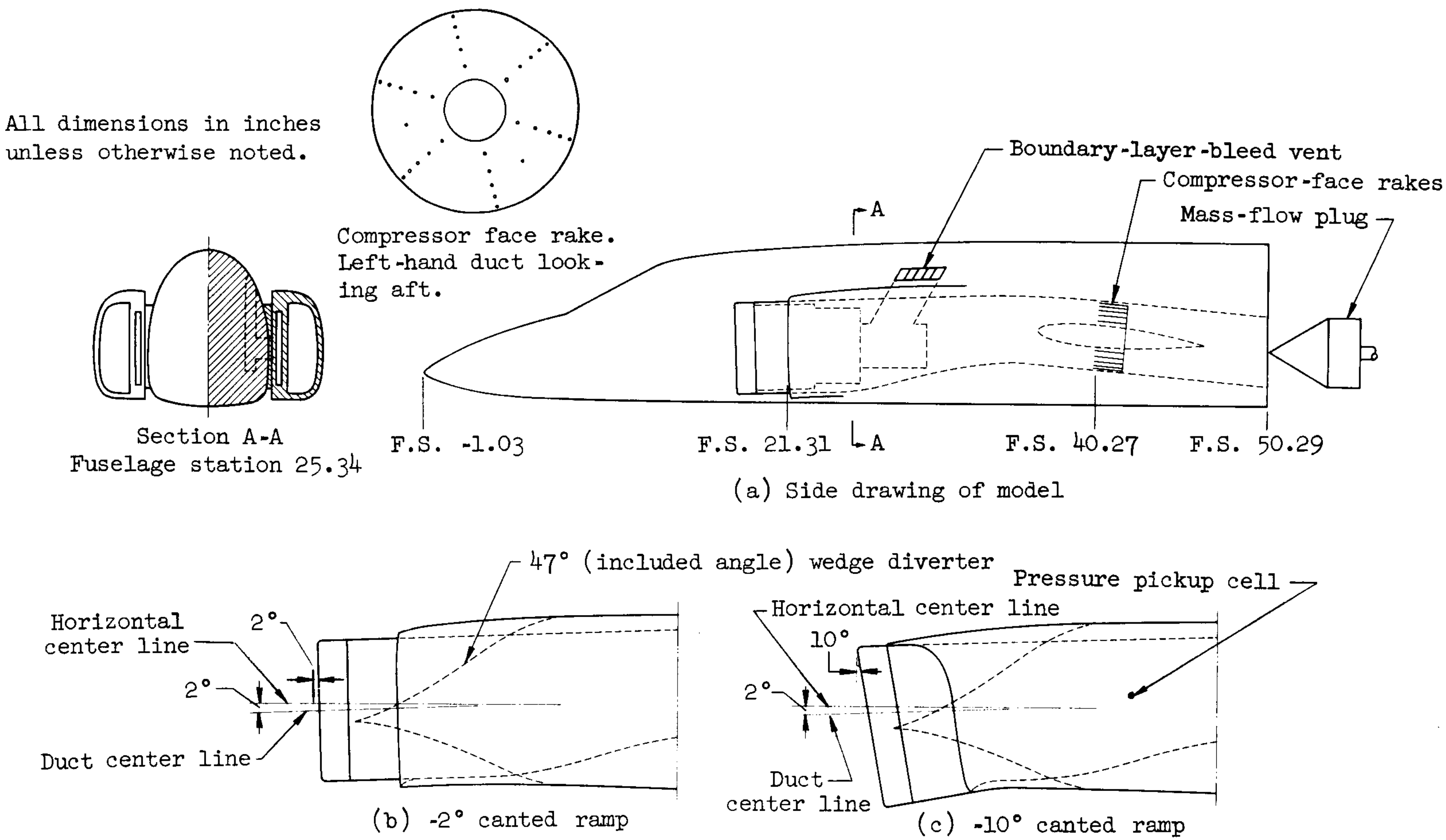

Figure 2.- Drawing of model fuselage and side inlets.

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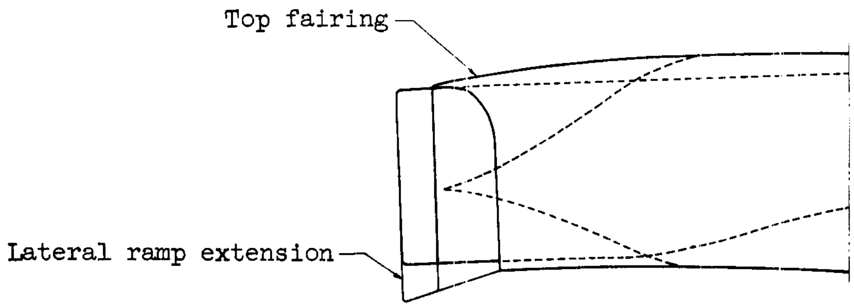
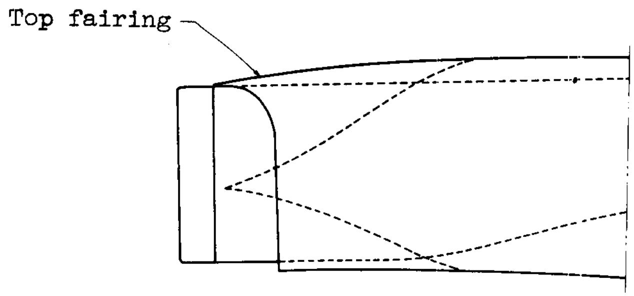
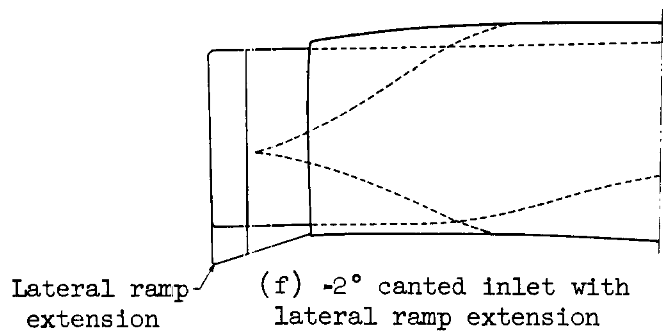


(d) -2° canted inlet with top fairing and lateral ramp extension



(e) -2° canted inlet with top fairing on



(f) -2° canted inlet with lateral ramp extension

Figure 2.- Continued.

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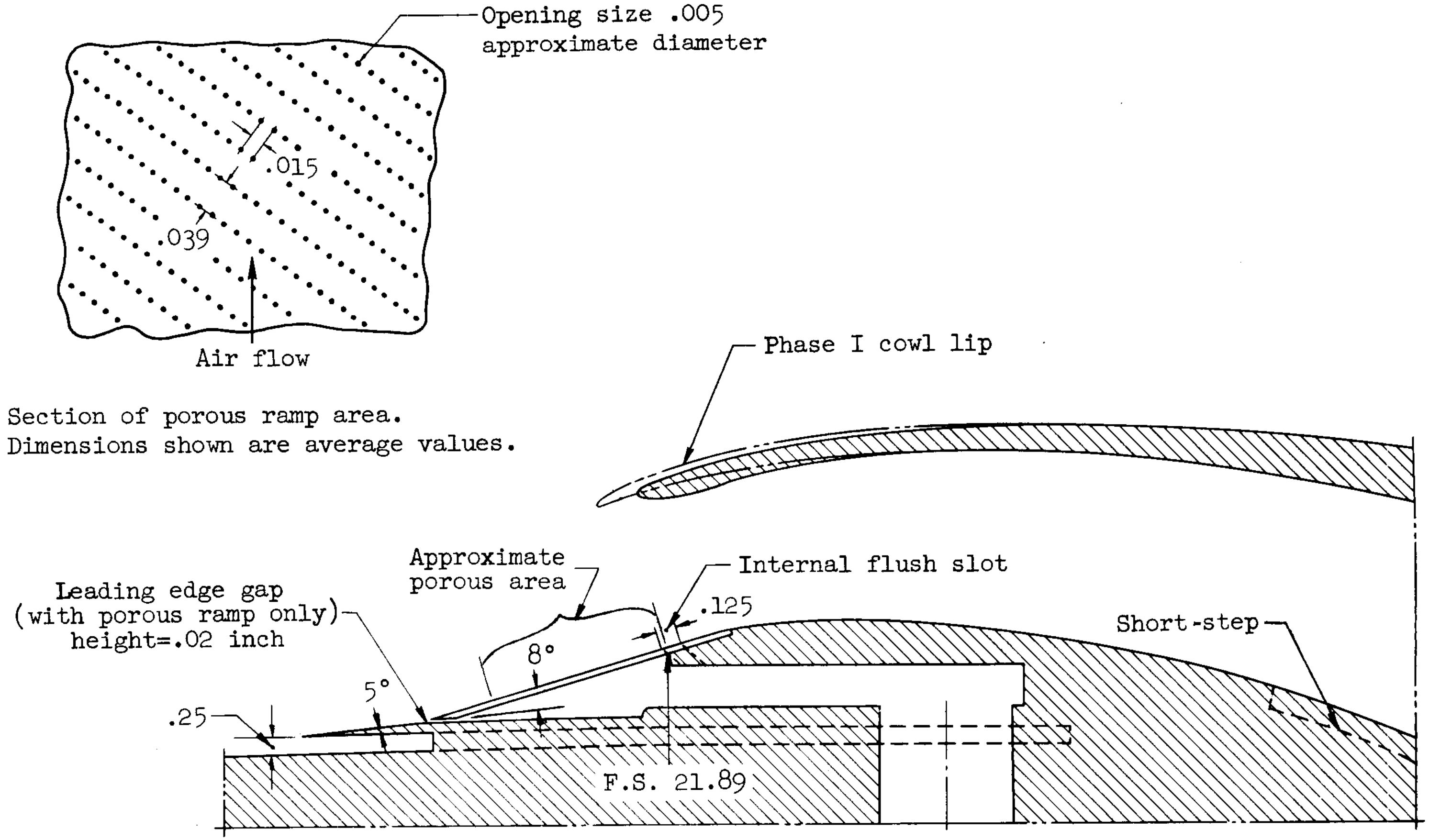
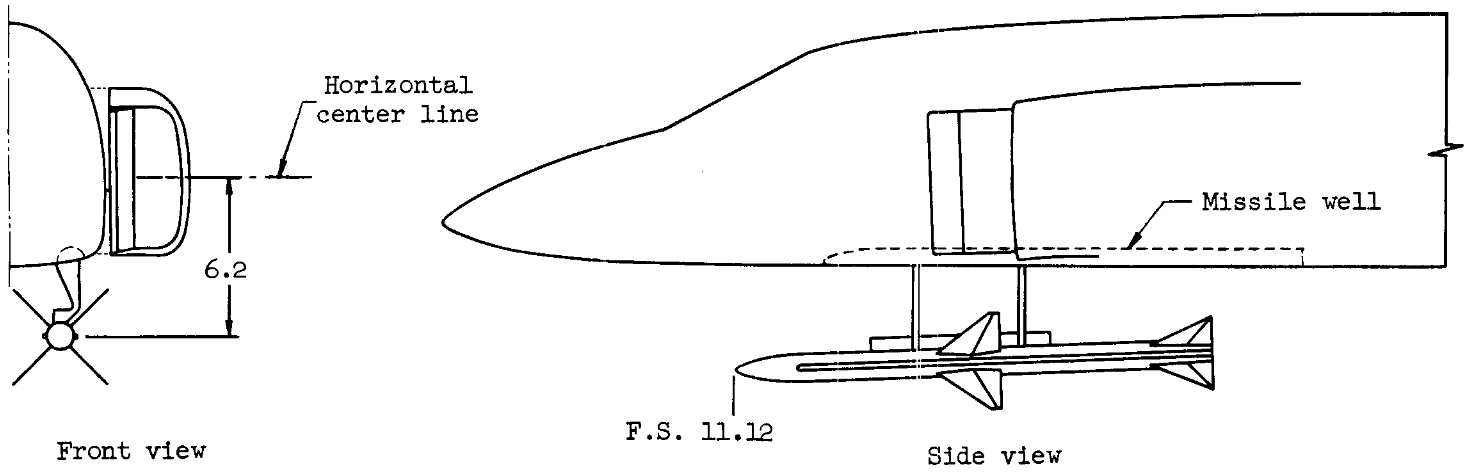


(g) Cross section of 5°-8° inlet.

Figure 2.- Continued.

[redacted]

All dimensions in inches



(h) Externally mounted missile.

Figure 2.- Concluded.

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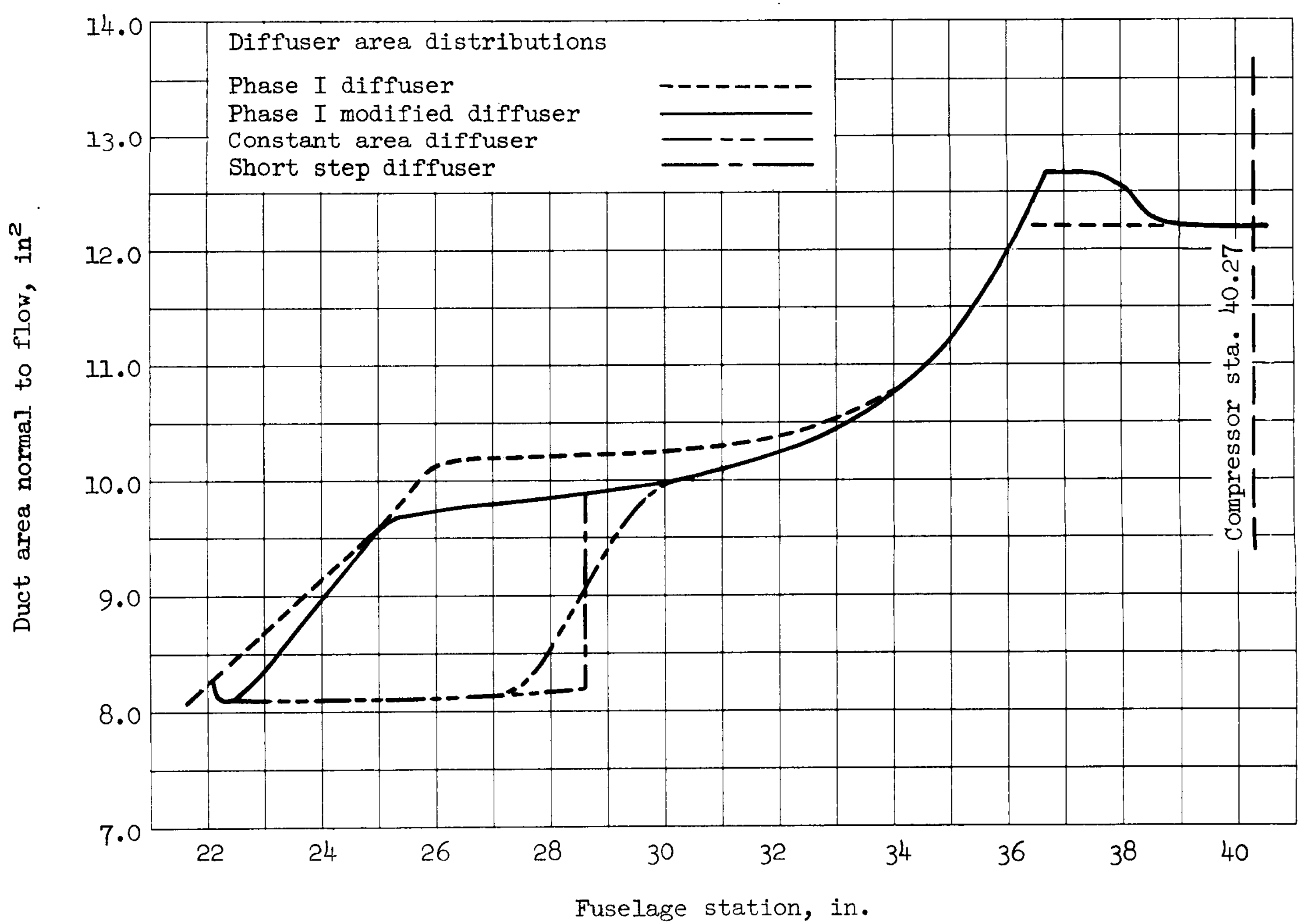

Figure 3.- Diffuser area distribution.

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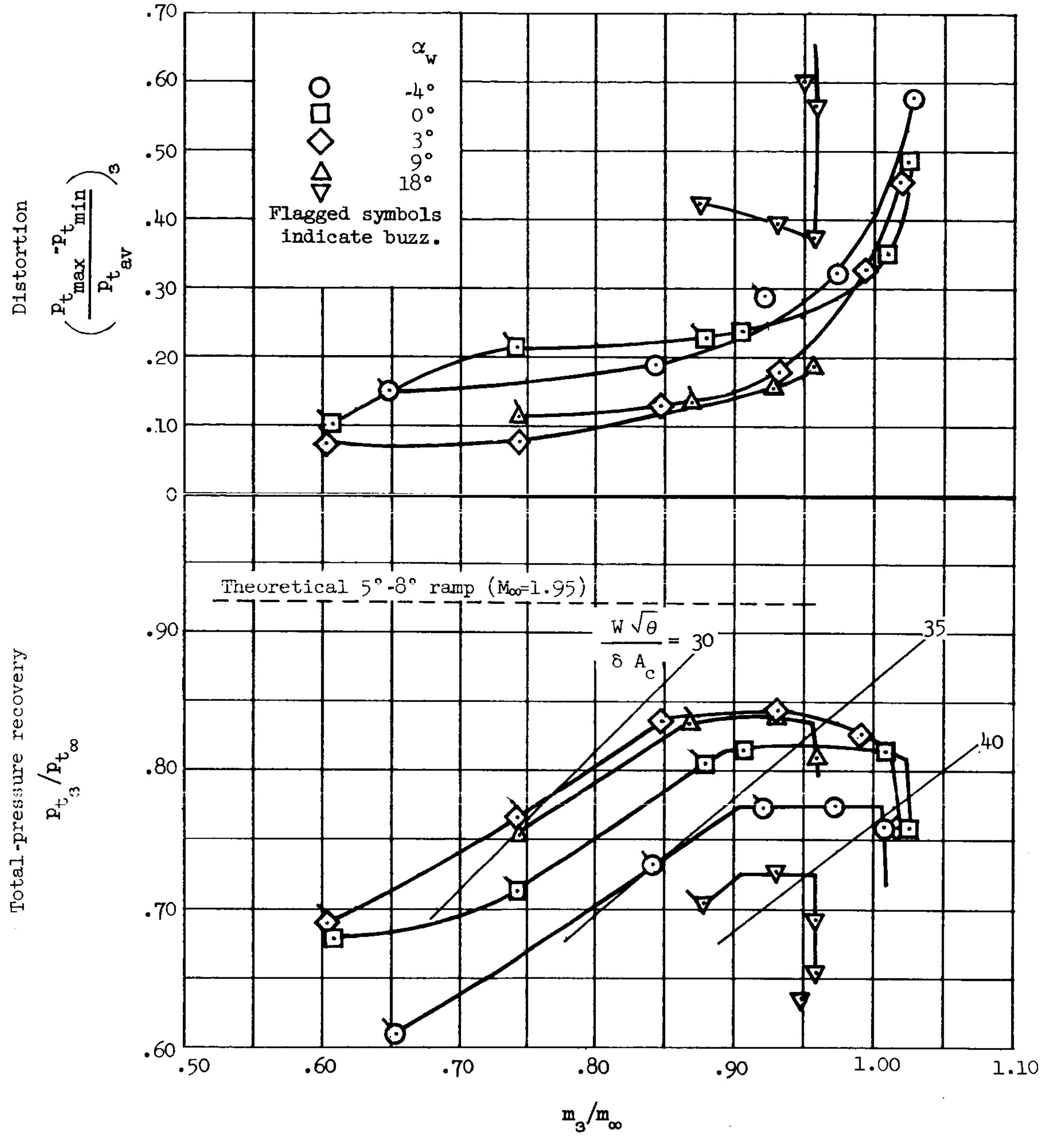

Figure 4.- Performance of basic 5°-8° double ramp side inlet; M_∞ = 1.95.

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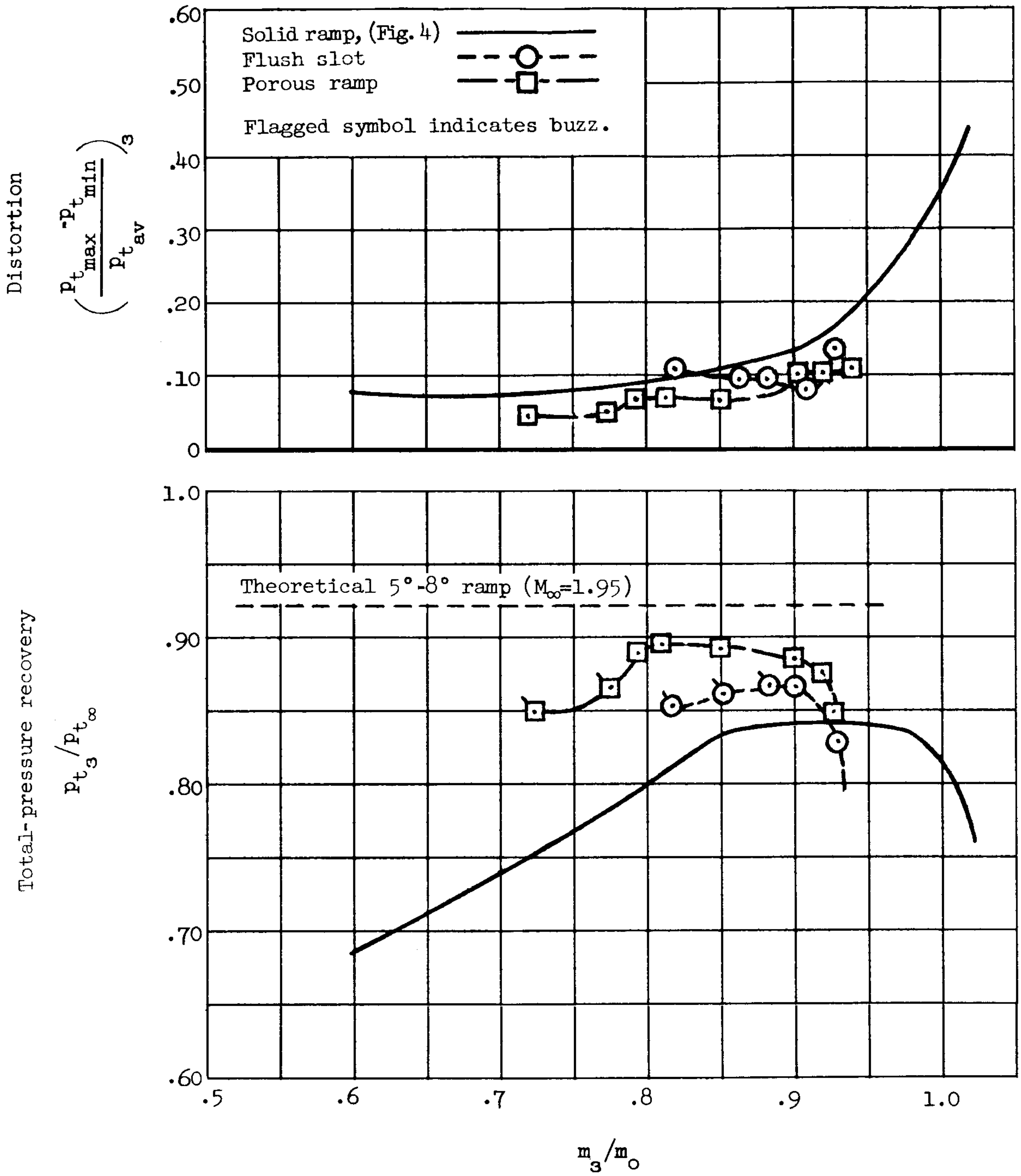

Figure 5.- Comparison of boundary-layer-removal methods; $M_\infty = 1.95$, $\alpha_w = 3^o$.

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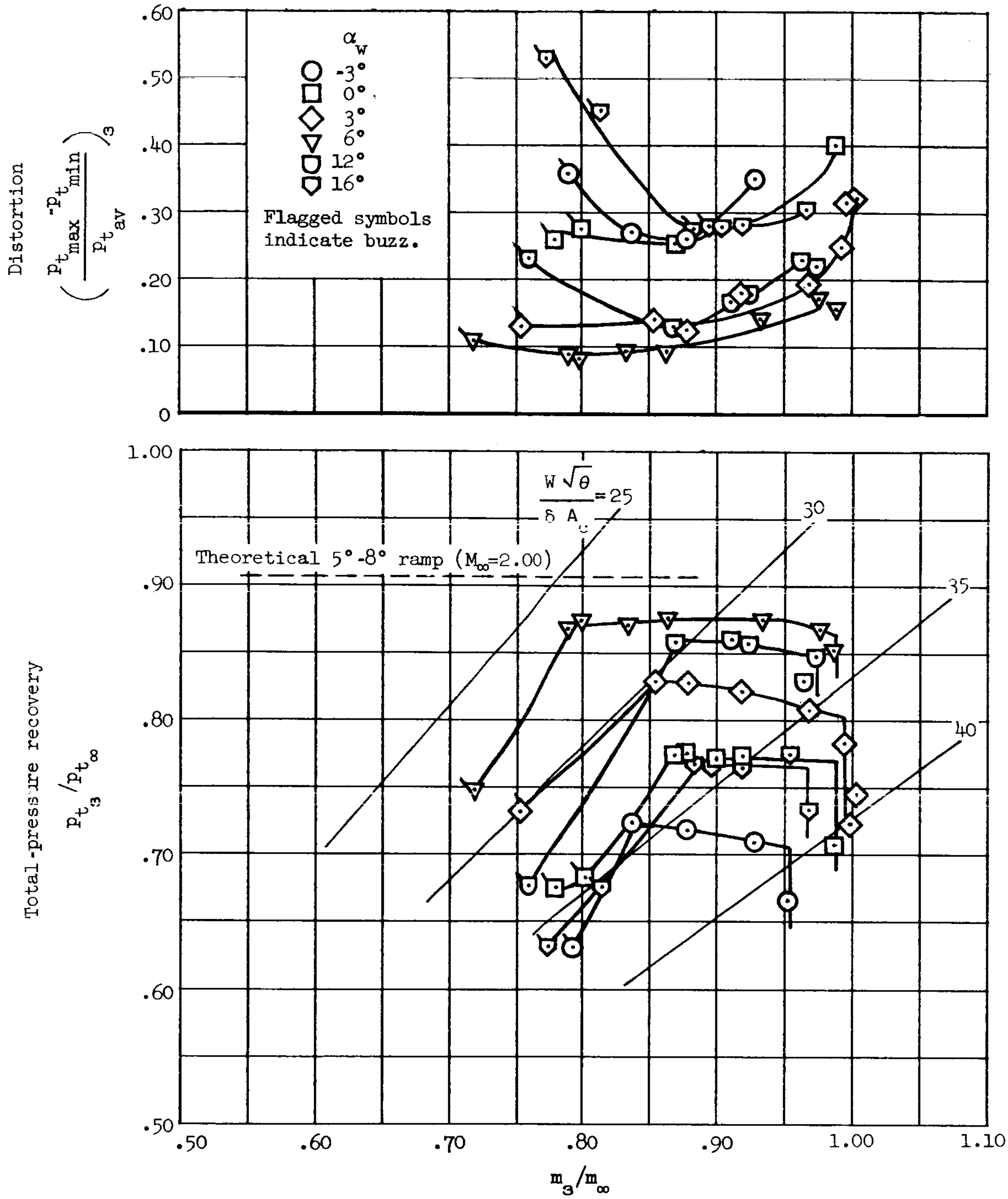

(a) -10° inlet cant, phase I modified diffuser, top fairing on, M_∞ = 2.00.

Figure 6.- Effect of inlet cant.

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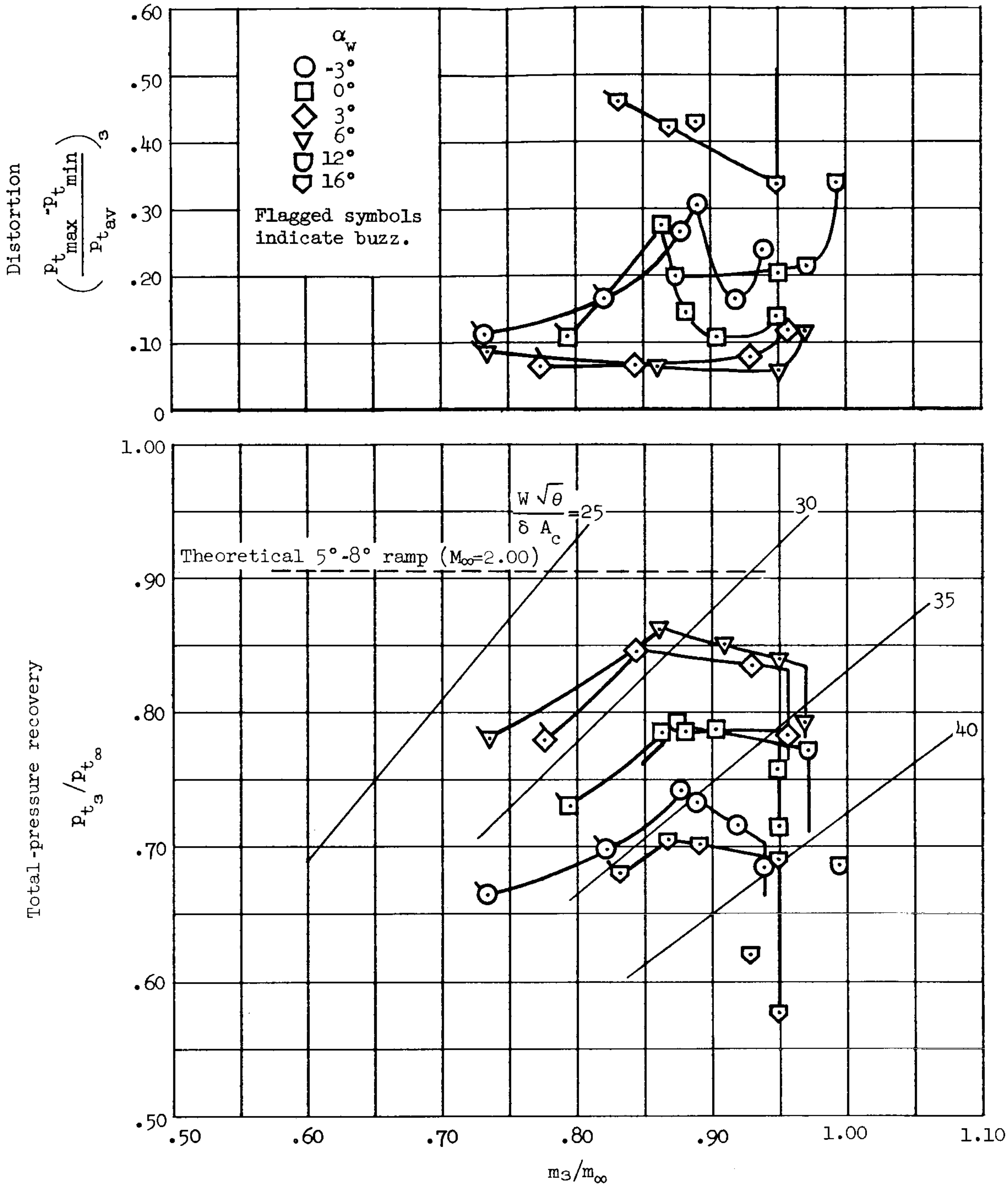
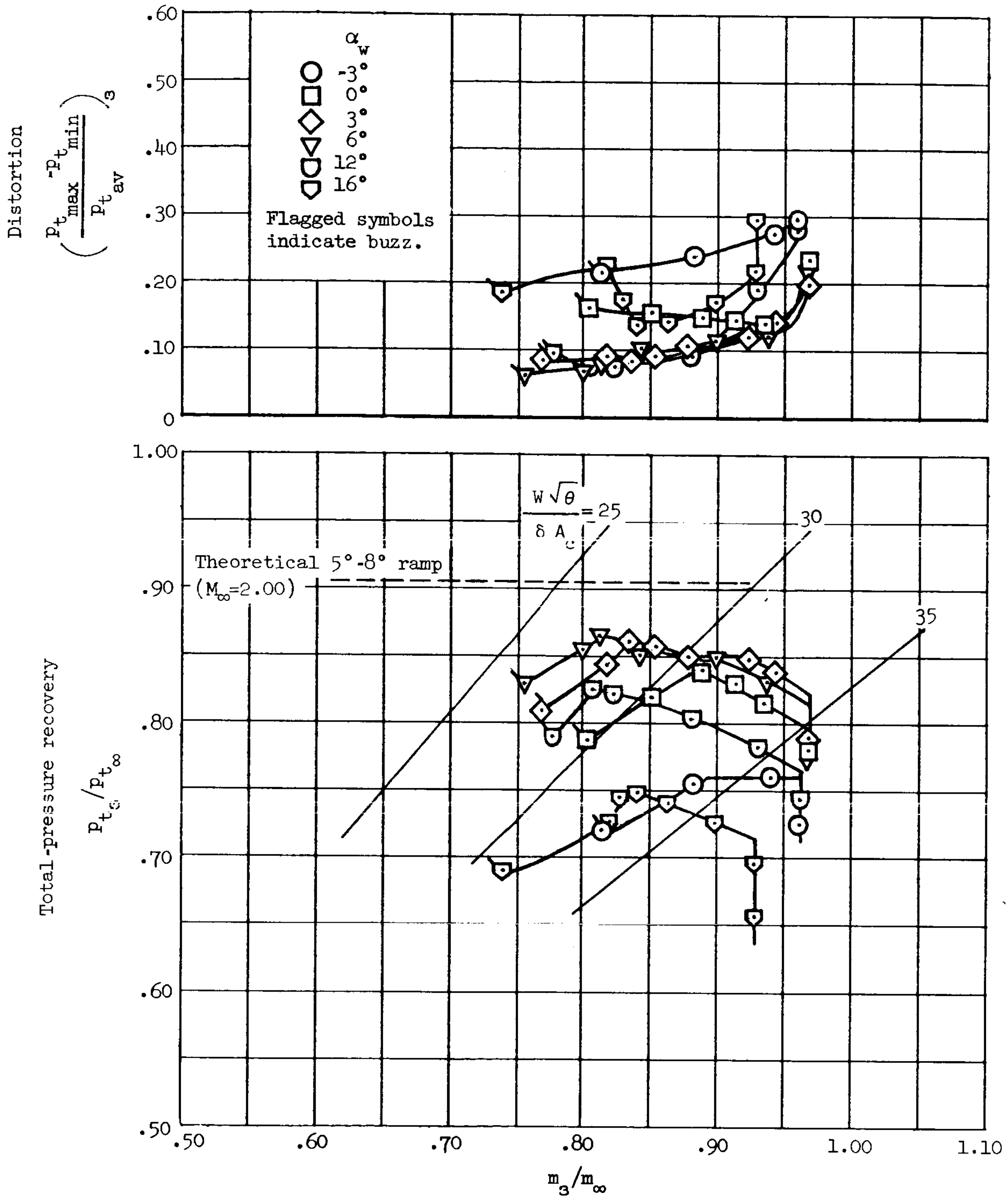


(b) -2° inlet cant, phase I modified diffuser, lateral ramp extension on, top fairing on, $M_{\infty} = 2.00$.

Figure 6.- Concluded.

[redacted]

[redacted]



(a) Lateral ramp extension on, -2 inlet cant, phase I modified diffuser, top fairing off, M_∞ = 2.00.

Figure 7.- Effect of lateral ramp extension.

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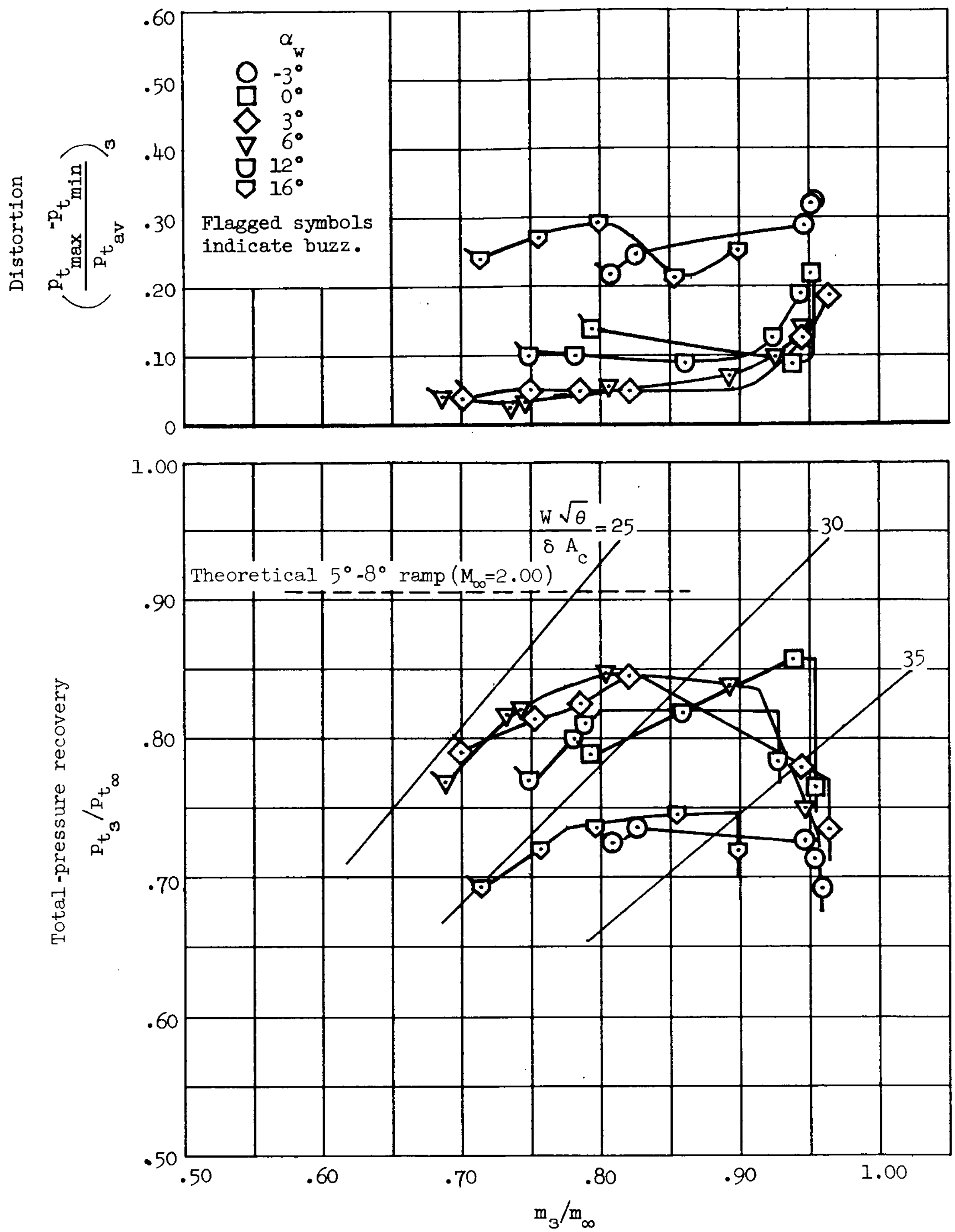

(b) Lateral ramp extension off, -2° inlet cant, phase I modified diffuser, top fairing off, M_∞ = 2.00.

Figure 7.- Concluded.

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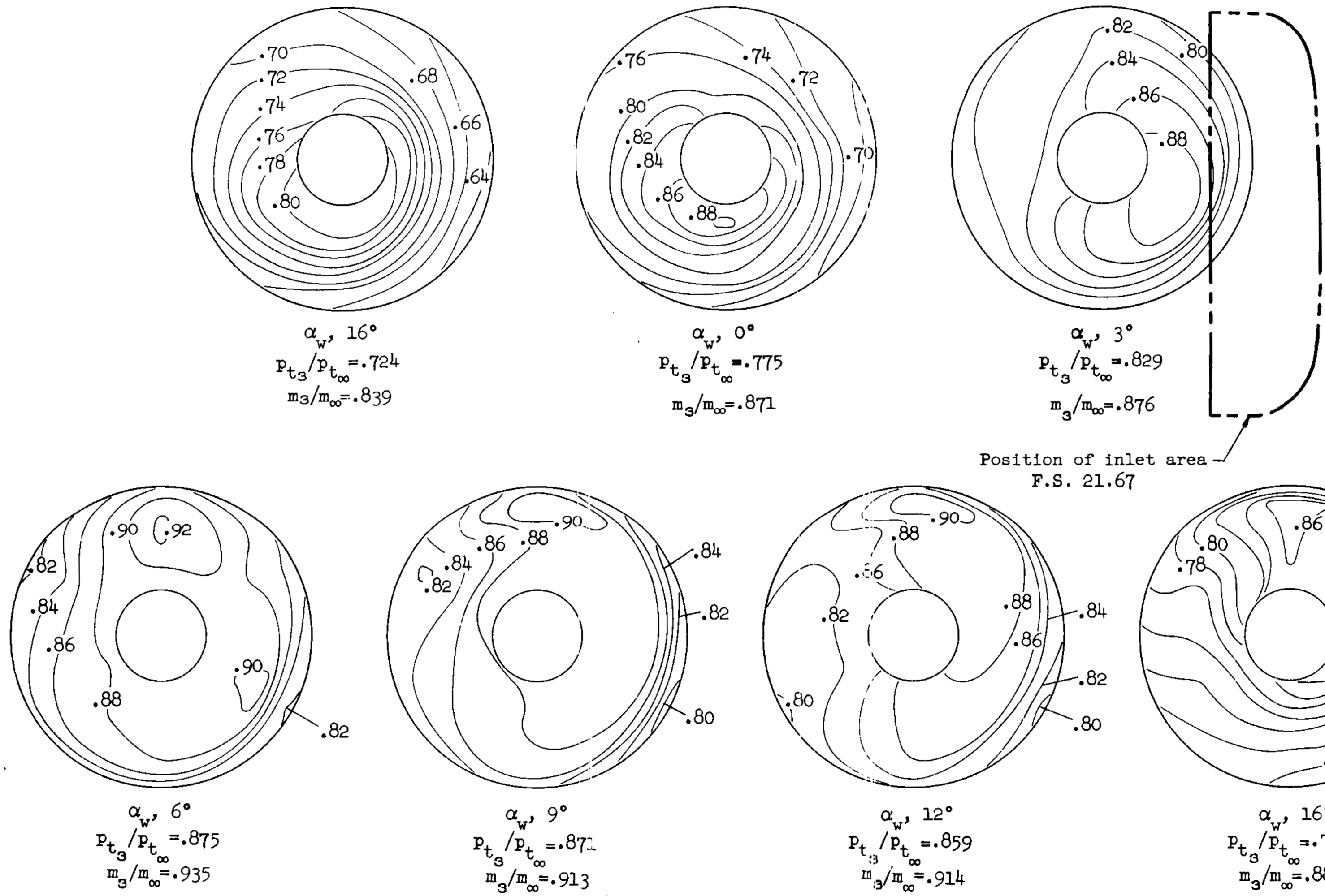

-10° inlet cant, constant area diffuser, M_∞=2.00

Figure 8.- Effect of angle of attack on compressor total-pressure recovery profiles.

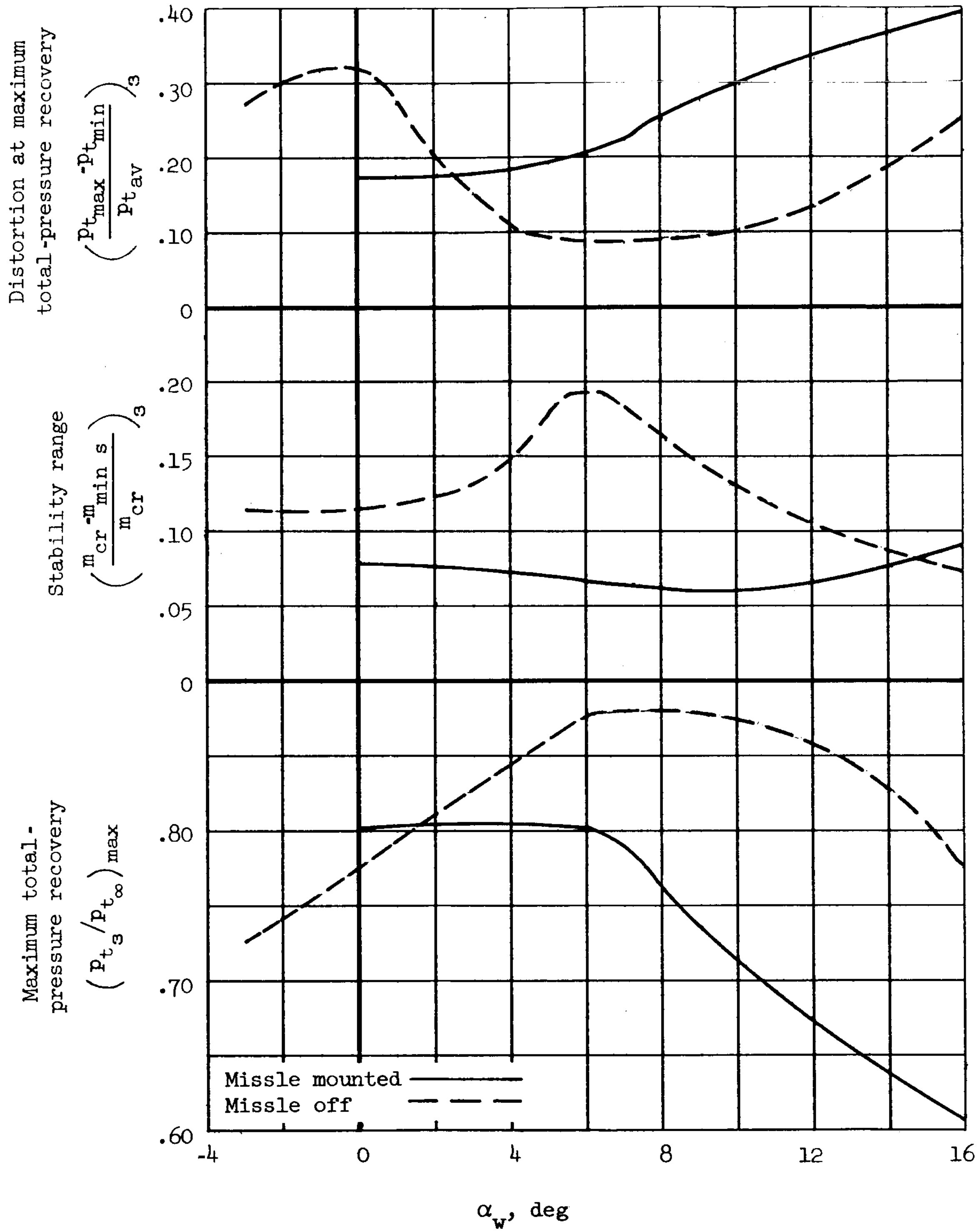

Figure 9.- Effect of externally mounted missiles, $M_\infty = 2.00$.

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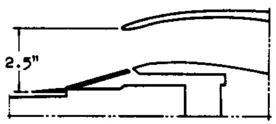
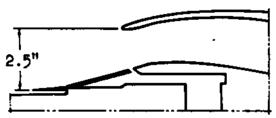
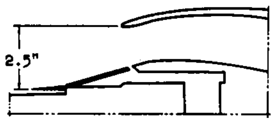
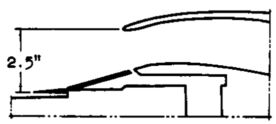
NOTES: (1) Reynolds number is based on the diameter of a circle with the same area as that of the capture area of the inlet.

(2) The symbol * denotes the occurrence of buzz.

Report and facility	Description			Test parameters				Test data				Performance		Remarks
	Configuration	Number of oblique shocks	Type of boundary-layer control	Free-stream Mach number	Reynolds number $\times 10^{-6}$	Angle of attack, deg	Angle of yaw, deg	Drag	Inlet-flow profile	Discharge-flow profile	Flow picture	Maximum total-pressure recovery	Mass-flow ratio	
CONFID. NASA MEMO 3-8-59A Ames 9- by 7-ft wind tunnel		2	Porous ramp and flush slot	1.6 to 2.0	0.88	-4 to 16	0			√		0.895 at $M_\infty = 2.0$	0.60 to 1.03*	Inlet ramp canted -2° and -10°. Top fairing and lateral ramp extension tested. Missile mounted in flow field tested.
CONFID. NASA MEMO 3-8-59A Ames 9- by 7-ft wind tunnel		2	Porous ramp and flush slot	1.6 to 2.0	0.88	-4 to 16	0			√		0.895 at $M_\infty = 2.0$	0.60 to 1.03*	Inlet ramp canted -2° and -10°. Top fairing and lateral ramp extension tested. Missile mounted in flow field tested.
CONFID. NASA MEMO 3-8-59A Ames 9- by 7-ft wind tunnel		2	Porous ramp and flush slot	1.6 to 2.0	0.88	-4 to 16	0			√		0.895 at $M_\infty = 2.0$	0.60 to 1.03*	Inlet ramp canted -2° and -10°. Top fairing and lateral ramp extension tested. Missile mounted in flow field tested.
CONFID. NASA MEMO 3-8-59A Ames 9- by 7-ft wind tunnel		2	Porous ramp and flush slot	1.6 to 2.0	0.88	-4 to 16	0			√		0.895 at $M_\infty = 2.0$	0.60 to 1.03*	Inlet ramp canted -2° and -10°. Top fairing and lateral ramp extension tested. Missile mounted in flow field tested.

Bibliography

These strips are provided for the convenience of the reader and can be removed from this report to compile a bibliography of NACA inlet reports. This page is being added only to inlet reports and is on a trial basis.

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